AMENDMENTS TO THE CLAIMS

1. (Original) A fiber optic tmperature sensor for measuring temperatures in a measurement range from less than -200° C to substantially beyond about 1,100° C, comprising:

a rigid sensor body of a heat-dissipating material;

a hollow tip member extending from the sensor body, the hollow tip member being made of a material capable of withstanding temperatures in the measurement range; and

an optical fiber disposed within the tip member, the optical fiber being made of a material capable of withstanding temperatures in the measurement range, the optical fiber terminating in a selectively reflective fiber Bragg grating made of materials capable of withstanding temperatures in the measurement range.

2. (Original) A fiber optic temperature sensor according to claim 1, wherein the optical fiber comprises sapphire.

3. (Original) A fiber optic temperature sensor according to claim 1, wherein the optical fiber comprises zirconia.

4. (Original) A fiber optic temperature sensor according to claim 3, wherein the zirconia is stabilized with yttria.

5. (Original) A fiber optic temperature sensor according to claim 1, wherein the fiber Bragg grating comprises layers of yttria-stabilized zirconia, wherein alternating layers have different concentrations of yttria to provide a desired difference of refractive index.

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

6. (Original) A fiber optic temperature sensor according to claim 1, wherein the fiber Bragg grating comprises alternating layers of alumina and zirconia.

7. (Original) A fiber optic temperature sensor according to claim 1, wherein the tip member comprises ceramic.

8. (Original) A fiber optic temperature sensor according to claim 1, wherein the sensor body comprises a metal sleeve from which the tip member extends.

9. (Original) A fiber optic temperature sensor according to claim 8, wherein the metal sleeve and the tip member of the sensor body are attached together by high-temperature cement.

10. (Original) A fiber optic temperature sensor according to claim 8, wherein the metal sleeve comprises copper.

11. (Original) A fiber optic temperature sensor according to claim 1, wherein the optical fiber is a first optical fiber, and further comprising a second optical fiber having one end disposed within the sensor body and optically coupled to the first optical fiber.

12. (Original) A fiber optic temperature sensor according to claim 11, wherein the second optical fiber is butt-joined to the first optical fiber with an anti-reflective coating interposed therebetween.

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

13. (Original) A fiber optic temperature sensor according to claim 11, wherein the second optical fiber comprises silica.

14. (Original) A fiber optic temperature sensor according to claim 11, wherein the second optical fiber is disposed within a rugged jacket, and wherein the jacket is disposed within the sensor body in a manner retaining the second fiber within the sensor body.

15. (Original) A fiber optic temperature sensor according to claim 14, wherein the metal sleeve and the tip member of the sensor body are attached together by high-temperature cement.

16. (Original) A system for measuring temperatures in a measurement range from less than -200° C to substantially beyond about 1,100° C, comprising:

a fiber optic temperature sensor having a tip portion with an optical fiber therein, the optical fiber being made of a material capable of withstanding temperatures in the measurement range, the optical fiber terminating in a fiber Bragg grating made of materials capable of withstanding temperatures in the measurement range and having reflectivity which is a function of wavelength of incident light;

a broadband light source being optically coupled to the optical fiber to transmit light along the optical fiber toward the fiber Bragg grating;

an optical spectrum analyzer optically coupled to the optical fiber to receive light reflected from the fiber Bragg grating back into the optical fiber; and

a processor operative to receive one or more electrical signals from the optical spectrum analyzer representing the

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

intensity of the reflected light across an optical spectrum including an optical wavelength at which an optical characteristic of the fiber Bragg grating is detected, the processor being further operative to determine a value of the optical wavelength at which the optical characteristic of the fiber Bragg grating is detected and to convert the determined wavelength value to a temperature value according to predetermined conversion criteria.

17. (Original) A temperature-measuring system according to claim 16, wherein the optical fiber comprises sapphire.

18. (Original) A temperature-measuring system according to claim 16, wherein the optical fiber comprises zirconia.

19. (Original) A temperature-measuring system according to claim 18, wherein the zirconia is stabilized with yttria.

20. (Original) A temperature-measuring system according to claim 16, wherein the fiber Bragg grating comprises layers of yttria-stabilized zirconia, wherein alternating layers have different concentrations of yttria to provide a desired difference of refractive index.

21. (Original) A temperature-measuring system according to claim 16, wherein the fiber Bragg grating comprises alternating layers of alumina and zirconia.

22. (Original) A temperature-measuring system according to claim 16, wherein the optical fiber is a first optical fiber, and further comprising a second optical fiber operative to

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

optically couple the temperature sensor to the light source and the optical spectrum analyzer, the second optical fiber having one end disposed within the temperature sensor and optically coupled to the first optical fiber.

23. (Original) A temperature-measuring system according to claim 22, wherein the second optical fiber is butt-joined to the first optical fiber with an anti-reflective coating interposed therebetween.

24. (Original) A temperature-measuring system according to claim 22, wherein the second optical fiber comprises silica.

25. (Original) A temperature-measuring system according to claim 22, further comprising an optical coupler having one bidirectional optical port coupled to the second optical fiber, the optical coupler having a light input optical port coupled to the light source and a light output optical port coupled to the optical spectrum analyzer.

26. (Original) A temperature-measuring system according to claim 16, wherein the optical spectrum analyzer comprises a photodetector array.

27. (Original) A temperature-measuring system according to claim 26, wherein the photodetector array comprises a charge-coupled device array.

28. (Original) A temperature-measuring system according to claim 16, wherein the optical characteristic is peak reflectivity.

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

29. (Original) A temperature-measuring system according to claim 16, wherein the processor is operative when determining the value of the optical wavelength at which the optical characteristic of the fiber Bragg grating is detected to:

i) obtain and normalize measured spectrum data from the optical spectrum analyzer when the system is operating at a measurement temperature; and

ii) compute an amount by which the normalized measured spectrum data must be shifted in wavelength to yield shifted normalized measured spectrum data in which the optical characteristic is most similar to the same optical characteristic in pre-established reference spectrum data.

30. (Original) A temperature-measuring system according to claim 29, wherein computing the amount by which the normalized measured spectrum data must be shifted comprises (i) calculating a difference function of the reference spectrum data and each of shifted versions of the normalized measured spectrum data, and (ii) identifying one of the shifted versions of the normalized measured spectrum data for which the calculated function yields a minimum value.

31. (Amended) A temperature-measuring system according to claim ~~20~~<u>30</u>, wherein the difference function comprises a least squares function.

32. (Original) A temperature-measuring system according to claim 29, wherein computing the amount by which the normalized measured spectrum data must be shifted comprises (i) determining a whole part representing an integer number of shift units, (ii)

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

determining a fractional part representing a fraction of a shift unit, and (iii) adding the whole and fractional parts together.

33. (Original) A temperature-measuring system according to claim 32, wherein determining the whole part comprises computing a least squares difference function of the reference spectrum data and each of shifted versions of the normalized measured spectrum data, and determining the fractional part comprises computing an extreme value function of the reference spectrum data and one of the shifted versions of the normalized measured spectrum data for which the least squares function yields a minimum value.

34. (Original) A temperature-measuring system according to claim 16, wherein the predetermined conversion criteria comprises a multiplicative factor representing a temperature difference per unit of shift.

35. (Original) A temperature-measuring system according to claim 34, wherein the multiplicative factor is determined by a calibration process that includes obtaining measured spectrum data at a known temperature different from the reference temperature, and dividing the difference between the known temperature and the reference temperature by an amount by which normalized spectrum data obtained at the known temperature must be shifted in wavelength to yield shifted normalized spectrum data in which the optical characteristic is most similar to the same optical characteristic in the reference spectrum data.

36. (Original) In a temperature measurement system employing a fiber optic temperature sensor and an optical spectrum analyzer optically coupled to the temperature sensor, wherein the

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

temperature sensor produces reflected light across an optical spectrum including an optical wavelength at which an optical characteristic of the temperature sensor can be detected, and wherein the optical spectrum analyzer is operative to produce electrical signals representing the intensity of the reflected light from the temperature sensor across the optical spectrum, a method of generating a measured temperature value based on the electrical signals, comprising:

establishing reference spectrum data from the electrical signals when the system is operating at a predetermined reference temperature;

obtaining and normalizing measured spectrum data from the electrical signals when the system is operating at a measurement temperature;

computing an amount by which the normalized measured spectrum data must be shifted in wavelength to yield shifted normalized measured spectrum data in which the optical characteristic is most similar to the same optical characteristic in the reference spectrum data; and

using pre-established conversion criteria to convert the computed shift amount to the measured temperature value.

37. (Original) A method according to claim 36, wherein computing the amount by which the normalized measured spectrum data must be shifted comprises (i) calculating a difference function of the reference spectrum data and each of shifted versions of the normalized measured spectrum data, and (ii) identifying one of the shifted versions of the normalized measured spectrum data for which the calculated function yields a minimum value.

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

38. (Original) A method according to claim 37, wherein the difference function comprises a least squares function.

39. (Original) A method according to claim 36, wherein computing the amount by which the normalized measured spectrum data must be shifted comprises (i) determining a whole part representing an integer number of shift units, (ii) determining a fractional part representing a fraction of a shift unit, and {iii} adding the whole and fractional parts together.

40. (Original) A method according to claim 39, wherein determining the whole part comprises computing a least squares difference function of the reference spectrum data and each of shifted versions of the normalized measured spectrum data, and determining the fractional part comprises computing an extreme value function of the reference spectrum data and one of the shifted versions of the normalized measured spectrum data for which the least squares function yields a minimum value.

41. (Original) A method according to claim 36, wherein the pre-established conversion criteria comprises a multiplicative factor representing a temperature difference per unit of shift.

42. (Original) A method according to claim 41, wherein the multiplicative factor is determined by a calibration process that includes obtaining measured spectrum data at a known temperature different from the reference temperature, and dividing the difference between the known temperature and the reference temperature by an amount by which normalized spectrum

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313

data obtained at the known temperature must be shifted in wavelength to yield shifted normalized spectrum data in which the optical characteristic is most similar to the same optical characteristic in the reference spectrum data.

WEINGARTEN, SCHURGIN,
GAGNEBIN & LEBOVICI LLP
TEL. (617) 542-2290
FAX. (617) 451-0313